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MEASURES FOR PRESERVING CYLINDER HEADS IN INTERNAL COMBUSTION ENGINES

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The cylinder heads in internal combustion engines are among the parts most subject to breakage. In the majority of cases, the damage occurs in the form of cracks on the bottom of the head between the valve and jet openings. The small crack, barely discernible at first, widens and deepens until the water from the cooling duct starts getting into the cylinders. In such cases the function of the head is impaired, and the dangers of hydraulic impact and piston scoring arise.

Replacing the head involves time losses and wasteful expenditure. The preservation of heads is, therefore, a problem worthy of attention.

The causes of cracks in cylinder heads are generally grouped as follows:

1. Thermal stresses resulting from unsatisfactory engine regulation; overloading the engine; disruption of the cooling system; defective construction of the head

2. Defective materials

3. Mechanical or hydraulic impacts

Long observation has shown that the most frequent cause of failure is inordinate thermal stresses, and that service life is shortened considerably when a poor grade of metal is used. Cases of mechanical defects in construction are rare.

Of the causes mentioned, that involving quality of the material is, to some extent, related to the persons using the head. These persons should specify exactly the type of material, iron or steel, to go into the head, give pertinent

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technical specifications and follow them up, at the same time requesting the data characterizing the material. It is entirely logical that the personnel of an installation have the right and obligation to reject heads made of poor-grade materials.

How the quality of the metal affects the head's service life is shown in the table below. The data presented might be extended. However, this is unnecessary since the facts are obvious.

Other causes of cracks in cylinder heads, particularly the thermal stresses, depend on an engine's structural factors and, to a great extent, on the system and conditions of utilization, and the qualifications of the attending personnel. This will be borne out if we analyze the nature of the origin of thermal stresses.

For example, in nonstationary heat flow, i.e., engine running and engine stopped, engine temperatures vary greatly over short periods of time. This causes thermal stresses considerably in excess of those encountered in the case of stationary flow. The former condition is, therefore, highly significant with respect to crack formation in the bottom of a cylinder head.

		Service Life of Head Made of	
Engine	Operation	High-Grade Metal	Unsuitable Metal
4-cycle, solid injection Skoda, Type 8 Ch 42.5/60 (by OST); 1,000 hp at 250 rpm	Almost daily running and stopping; cooled by cold water through circulating system.	Alloyed cast iron, Type LCh; 23,000-29,000 hr	Cast iron, similar to Type SCh-15-32 w/ S-content ca .21 to .22%; 3,000-7,000 hr
4-cycle, solid injection, Kolomna plant, Type 60G-6; 600 hp at 187 rpm	Same as above	High-grade, cast iron, Type SCh-21-40; 11,500-14,200 hr	Same, but w/ S-content up to .20%; 2,300-7,200 hr
4-cycle air injection, Kolomna plant, Type 20k-4; 465 hp at 187 rpm	Continuous for 700-720 hr; cooling by circulating sea water	Cast iron, Type SCh-21-40; 15,200-19,400 hr	Low-grade, cast iron, head manufactured locally; 5,100-9,350 hr
4-cycle, air injection, "Russkiy Dizel'," Type N-74; 150 hp at 175 rpm	Frequent start and stop; circulation cooling	High-grade, cast iron, Type SCh-21-40	Cast iron, Type SCh-15-32 w/ high P content; 4,800-6,350 hr
2-cycle, solid injection, "Russkiy Dizel'," 6RK-30; 3000 hp at 300 rpm	Same as above	Same as above; 12,000-19,320 hr	Low-grade, cast iron, head manufactured locally; 4,270-8,910
2-cycle, air injection, "Russkiy Dizel'," 2126; 500 hp at 187 rpm	Same as above; (w/ cold water circulation)	Same as above; 14,380-17,690 hr	Cast iron, Type SCh-12-28 w/ excessive S and P contents; 2,210-3,860 hr
4-cycle, air injection, KhPZ plant, Type ODV; 400 hp at 167 rpm	Same as above	High-grade, cast iron, (type unknown), KhPZ plant product; 16,850-19,540 hr	Cast iron, Type SCh-15-32, w/ S content .22%; 3,920-6,175 hr

On the basis of observations, the following measures are recommended for lengthening the service life of cylinder heads in internal combustion engines:

1. When ordering replacement or spare heads require that the supplier prepare them either from Type SCh-24-44 cast iron, which is the minimum acceptable for low-speed engines, or from Type SCh-28-48, or Type ChL cast iron, in the case of high-speed engines, with compulsory annealing prior to final processing or natural aging.

Particular attention should be paid that the sulfur content of the iron not exceed 0.12%.

Certificates should be supplied with the heads specifying results of tests on melt samples for bending, Brinnel hardness, sulfur content, and also the results of hydraulic pressure tests on the cooling ducts.

2. Examine all heads received carefully for defects and for nonconformity to specifications.

3. Heads accepted should be cleaned, oil-coated for protection and placed in dry cold storage until used.

4. When mounting the head. clean all surfaces thoroughly, check all joints and connections, and tighten head bolts carefully.

5. Examine cooling ducts and flush when necessary.

6. To stabilize and reduce thermal stresses, use a large quantity of warm water, keeping jump in temperature before and after the engine to not more than 20°C with the engine under nominal load. If cold water circulation is used, to avoid an increase in the thermal load (large jump in temperature), part of the warm water coming from the engine should be mixed with the cold water in front of the engine. Temperature of the mixture should be about 35 to 40°C. If the flow of cooling water is interrurted, the engine should be stopped and allowed to cool gradually. In normal stoppage, flow of cooling water should be maintained for an extra 5 to 10 min at reduced volume. All cooling ducts should be filled with water before the engine is started.

7. To reduce thermal stresses when stopping, the engine should be allowed to idle at least 5 min without load. When starting, after a 5-min idling period, load should be taken on as gradually as possible, as the engine heats up. No load exceeding 75% of the engine's nominal capacity is to be placed on the engine during the first 15 min of operation.

8. There should be systematic observation of exhaust gas temperature, individual cylinder behavior, and fuel combustion, and any defects observed should be corrected immediately.

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